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Science Summit Priority Needs

REGION 1

Title: The Impact of Residential and Commercial Land Use on New England's Water Quality

Problem Statement: Land use that is poorly planned can significantly degrade the quality of our water resources compromising the quality of life for people in both urban and rural environments. Over the past 5 years, the national rate of development more than doubled to over 5 million acres per year. Location, nature, rate of development and intensity of land use is already an identified critical national problem and the impact this problem presents to regulators dealing with water quality is certainly at the top of the environmental agenda for states in the northeast.

Background**:** Community development and growth typically results in a greater number of impervious surfaces; adds to the waste water infrastructure loads; and reduces ecosystem barriers which leads to storm water runoff and flooding. This point and non-point source contamination in many instances causes irreparable damage to our streams, rivers, and wetlands. Couple this with existing elicit sewer connections, aged wastewater infrastructure systems, combined sewer overflows and dated septic systems, communities both old and new are faced with the challenge of determining what are the Best Management Practices (BMPs) and cost effective options for protecting our water resources when either rectifying an existing problem or when designing a new community?

There are immediate environmental threats posed from both point source and non-point source discharges to watersheds and abutting ecosystems. Nutrient loading and anthropogenic emerging contaminants (ie: pharmaceuticals, PPCPs, pesticides and herbicides, endocrine disruptors, etc.) all contribute ecosystem habitat loss; decreases in species diversity; and increases in water quality impairment from sediment and nutrient loading. The variable nature and intensity of these discharges create challenges for the Clean Water Act programs including the development of sound, supportable TMDL and NPDES permits.

What is Needed in the Near Term:
• Storm water control technologies supported by quantitative documented performance effectiveness values for structural and non-structural Best Management Practices (BMPs) to reduce adverse impacts from storm and wet weather flow events.
• Design ideas for the incorporation of Low Impact Development and Smart Growth principles and practices in Stormwater Phase II permits and TMDL implementation plans.
• Affordable wastewater treatment technologies for town centers in small currently-unsewered communities so that future development does not drive the community to large lot septic systems.

• Need updated efficiencies and cost information on technologies for the removal of nutrients, bacteria, and emerging contaminants to ensure compliance with water quality based NPDES permit limits for storm water and POTWs.
• Documented pollutant removal effectiveness information for control and mitigation technologies that address sediment runoff caused by back roads, agriculture, impervious surfaces, and urban residential and commercial development, etc.
• Protocols for designing and implementing ecosystem BMPs to reduce watershed and wildlife corridor fragmentation.

What is Needed in the Long Term:
• The development, verification, implementation, and maintenance of effective practices and behaviors to reduce urban storm water pollution in order to meet water quality standards.
• Technical assistance to communities to help them revise their zoning and regulations to incorporate environmentally sound practices resulting in low impact development and energy efficiency leading to water infrastructure best management.
• Routine delivery (every 5 years) of a handbook with innovative commercially ready technology solutions for reducing nutrient loading and managing storm water overflow.
• Guidance designed for community planners that shows how to protect ecosystems and watersheds while allowing for economic development.

Implications of No Action: Based on trend data over the past 25 years, poorly planned development will continue to wreak havoc with our fragile watersheds and ecosystems reducing wetland habitats and enhancing our regulatory problems with nutrient loading. Without reliable, defensible, and quantifiable data on BMPs for storm water and wastewater discharges, it becomes impossible to implement TMDLs in support of our NPDES permit programs. Moreover, it is self evident that urban sprawl that does not take into account green infrastructure planning with the appropriate education of the public will continue to increase health risks to the public.

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REGION 2

Title: Nitrogen Indicator for Estuarine Systems (#1 Tech Support)

Issue:
Nitrogen has been identified as an issue throughout Region 2 estuaries in terms of its eutrophic effect on the natural ecosystem. Barnegat Bay, a semi-enclosed bay along the central New Jersey coastline, has been identified as the subject for a study in developing a reliable nitrogen indicator for eutrophic conditions. Barnegat Bay's watershed is roughly delineated by the boundaries of Ocean County, NJ, which is the fastest growing

county in the state and one of the fastest growing counties in the Northeast. The Barnegat Bay National Estuary Program (BBNEP) has, as its main goals, the protection of water quality, living resources, and compatible human uses within the bay and watershed.

While the water quality of Barnegat Bay remains, by some measures, relatively good, it has reached a highly eutrophic state which appears to be adversely affecting the natural estuarine ecosystem. Nitrogen inputs from storm water and non-point sources originating from the ever-increasing development of Ocean County are having a bearing on the ecological health of the estuarine system. A once-productive hard clam fishery has nearly disappeared and there is evidence that eelgrass beds, a dominant estuarine habitat in the bay, are in a degraded condition. Irruptions of invasive species, such as brown tides and sea nettles (stinging jellyfish), add to the evidence of a serious adverse ecological condition in the bay.

ORD Involvement:
The BBNEP has identified nine primary indicators of Barnegat Bay environmental quality, several of which deal in some way with the issue of nutrient inputs to the bay. These include: submerged aquatic vegetation distribution; signature species; shellfish beds; and harmful algal blooms. Because of the apparent worsening ecological condition in the bay, the BBNEP has contracted with Rutgers University to study development of a nutrient pollution indicator by measuring the ratio of leaf blade nitrogen concentration in eelgrass to the leaf mass. Recent studies in New England have found in eelgrass samples that the area normalized leaf mass exhibited a consistently negative relationship with leaf tissue nitrogen. ORD involvement would include lending technical assistance to this study in the form of guidance and review of results.

Title: New York Metro Climate Change Sensory Network (#2 Tech Support)

Concept: Build an integrated urban climate sensory observatory for the New York City Metropolitan Area.

This project would be designed to track indicators of climate change in the aquatic and atmospheric environment; analyze the data in context with other available contemporaneous information; and determine climate change-related impacts and trends specifically for the 31 county metropolitan area. We propose to foster the development of a network that incorporates use of data available from research and observation stations already in-place (and proposed) for meteorology, harbor estuary waters, air quality, atmospheric conditions, and the urban heat island. EPA Region 2 anticipates that the empirical and analytical data generated by this project would, in the long term, be used by the following:

- Electric power providers in projecting daily energy demand, as affected by heat island size/intensity and changes in on-shore/off-shore breeze patterns.
- Water managers in anticipating and managing for algal blooms, hypoxia episodes, changes in salinity, changes in pH and other climate-related impacts.

- Wetlands and beach managers in anticipating ecological and physical changes to resources under their purview (specific applications would relate to wetlands disappearance, beach erosion, beach closings, etc.)

In the short term, the Region wants to establish a stakeholder workgroup that could consist of organizations presently doing sensor work in the New York City metro area. This workgroup would work on the development of the network described above.

ORD Role: Region 2 envisions ORD participating in four critical areas:

- Working with stakeholders to identify appropriate meteorological and water quality sensors.
- Identification of appropriate and readily measurable climate change indicators.
- Design of a real time data integration platform.
- Development of specifications and standard operating procedures for this system so it can be replicated in other metropolitan areas domestically and internationally.

Potential Partners:

- NASA-Goddard Institute of Space Studies with the Columbia University Earth Institute and Hunter College City University of New York who want to expand their existing network of meteorological stations in New York City.
- The Center for Maritime Systems at Stevens Institute of Technology Davidson Laboratory which operates a system of stationary buoys in the New York Harbor Estuary along with one unmanned robotic vehicle (URV).
- EPA OAQPS: National Ambient Air Monitoring System
- EPA Region 2: DESA, DEPP (Energy and Climate Change Expert, Long Island Sound Office, Air Program Branch)

Title: Innovative Technologies for Capping Contaminated Sediments (#1 Research)

The selection of remedial measures for dealing with contaminated sediments at river system Superfund sites is one of the Regional Administrator's top priorities. Although dredging has been the most commonly utilized option for remediation of contaminated sediment sites, there continue to be concerns about the effectiveness of remedial dredging, as most recently reported in the National Academy of Sciences publication entitled "Sediment Dredging at Superfund Megasites: Assessing the Effectiveness," which was released as a "prepublication copy" in June 2007.

Capping is the chief alternative to dredging, but it has its own potential problems such as interference with navigation, altering surface water flow patterns (possibly with increased likelihood of flooding) and deterioration with passage of time. However, there are innovative technologies intended to address these problems. These include permeable reactive mats and low permeability caps.

In some cases, permeable reactive mats as a capping option have been ruled out, because they had not been employed full-scale (although this is no longer the case). The Anacostia River has a pilot-scale permeable reactive mat, which includes a layer of coke sandwiched between geotextile layers. Recently, a full-scale (11 acre) permeable reactive mat including activated carbon sandwiched between geotextile layers, was installed at a State Superfund site in Duluth, MN to cover PAH-contaminated sediments. The Anacostia River also has a pilot-scale impermeable "AquaBlok" cap, which ORD has been evaluating. Relatively impermeable composite liners incorporating geotextile layers (which have been used for lining landfills) are also potentially applicable for sediment capping. Because geotextile-based mats are manufactured in a factory (in the form of large sheets rolled into cylinders), much greater quality control can be attained compared to conventional caps.

An important issue, at these type of superfund sites, is balancing the amount of dredging versus the amount of capping. Geotextile treatment mats can be very thin, with the Anacostia River mat having a thickness slightly greater than 1 cm. A similar thickness can be attained for relatively impermeable geotextile-based mats which contain an impermeable material, such as clay and/or a membrane liner. Although additional thickness may be needed for protective armoring and/or to provide a suitable environment for returning benthic organisms, the total thickness for such innovative caps is likely to be much less than for traditional caps (such as those consisting of clean sediment, sand and/or gravel). The use of innovative capping technology would help to minimize the volume for which dredging and subsequent disposal of dredged materials will be needed.

The assistance that the Region is requesting would involve evaluating existing innovative capping technologies for potential applicability to river systems and/or conducting additional research (preferably site-specific) on this topic. The ORD assistance would be valuable in the remedy selection process and/or the remedial design process, both of which will contribute to meeting the Regional Administrator's goal for remediation of contaminated sediments sites.

> **Title:** Developing an Emission Signature for Diesel Particulate Matter (PN) to Determine the Relative Contribution of Diesel PM to Monitored PM Levels (#2 Research)

Background:
There are many health and air quality issues associated with particulate matter (PM) air pollution, and diesel exhaust is a primary contributor to PM pollution in many areas. Diesel-powered vehicles are estimated to release 300 million pounds of coarse particulate matter (PM_{10}) and 268 million pounds of fine particulate matter ($PM_{2.5}$) annually to the ambient air. Diesel particulate matter (PM) is known to exacerbate asthma and other respiratory conditions and may be a human carcinogen. Two national associations of regulators have estimated based on lifetime risk, that diesel PM is responsible for 125,000 cancer cases in the U.S. In addition, diesel exhaust also contains 40 hazardous air pollutants listed by EPA.

Diesel engines are ubiquitous and long lasting, and they are used in a variety of applications ranging from primary engines for buses, trucks, locomotives, construction equipment and marine vessels. The specific sources of diesel PM differ from area to area, and often the most significant sources are found in close proximity to low-income and minority communities.[1] This pattern is also consistent with numerous studies showing that a higher percentage of stationary air pollution sources, such as factories and power plants, are also concentrated in such areas.

To develop effective control strategies to address localized elevated PM levels, it would be very valuable to know which emission sources are dominating contributors to the elevated levels of PM at a given location. By being able to directly correlate monitored PM levels to very specific sources in the area, regulators would be able to craft control strategies to meet the specific needs of areas that range in size from broader non-attainment areas, down to the community level where localized impacts can be the most severe.

Research Goals:
The goal of this research would be to develop a reliable method or set of methods to identify the relative contributions of different PM emission sources - including stationary vs. mobile source, highway gasoline engines vs. highway diesel engines, and highway diesel engines vs. non-road diesel engines - to overall monitored PM levels in a specific area or location. This could be accomplished by determining a specific "emission signature" attributable to different emission sources, with specific emphasis on developing signature or "marker" emission component or components specific to highway diesel PM and non-road diesel PM. The marker could be an element or compound and/or concentration of same that is unique to a specific type of engine or engine use.

1. After an intense year-long investigation of diesel exposures, NRDC investigators found in a majority of cases that the greatest concentrations of diesel vehicles – at bus depots, distribution centers, and industrial facilities – were typically located in low-income and minority communities.

Title: Addressing Increased Exposure in the Aging Population due to Methylmercury Exposure (#3 Research)

Problem Issue:
The advisories issued by US EPA and US FDA to limit fish consumption are to avoid excessive exposure to methylmercury. This addresses the health risks of methylmercury exposure to pregnant women. Limiting maternal exposure to methylmercury is an an effort to protect the developing fetal nervous system from the adverse effects of this well-established neurological toxin.

Current understanding of dose-response to methylmercury centers on the long-held concept that the fetal nervous system is affected by methylmercury exposure far lower than those affecting adults. Nonetheless, there is mounting evidence that methylmercury

may adversely impact adult neurological functions at exposures occurring in the United States and European populations.

This could significantly impact our dramatically aging population. In NYS alone, the 60 and older population is projected to increase 40% over 30 years(US Census). Concern for this growing population is the fact cardiovascular disease is the number 1 killer in NY State causing the death of over 40% of our population. CV patients are routinely told to increase fish consumption.

One of the major reasons for increasing fish consumption is to increase dietary intake of omega-3 fatty acids. These are considered to be protective and to slow the progress of multiple types of heart disease. Unfortunately the omega-3 fatty acids predominately occur in fish. Increasing fish intake increases exposures to methylmercury and additional organic toxins. Methylmercury exposure has been associated with an increased risk of coronary heart disease in two of three major cohort studies conducted in the United States and Europe.

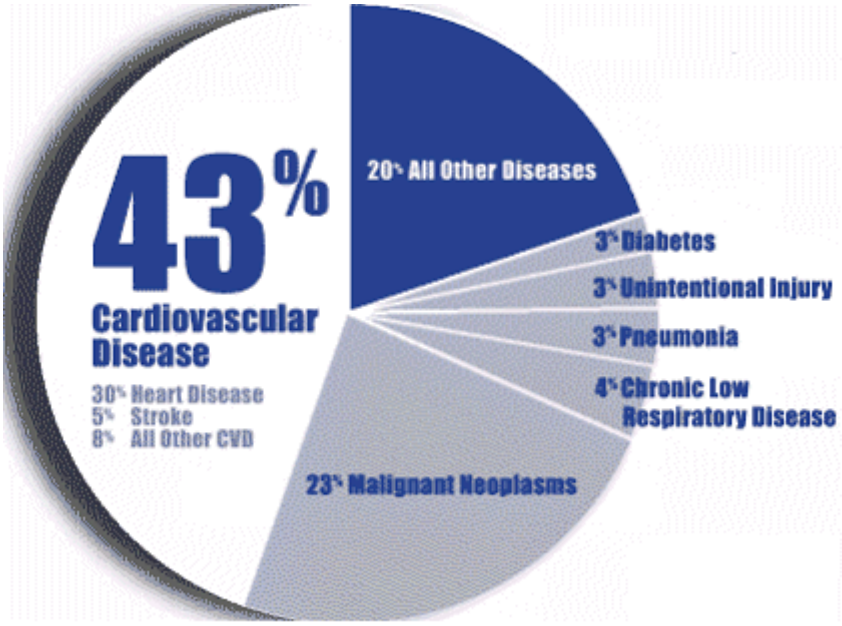
Contaminated fish are not expected to disappear from the markets, and the aging populations are not addressed in any of the current fish advisories. In fact, people are encouraged to eat fish as part of their healthy diet. It is often assumed that there is no reason to limit fish consumption in the adult population (excluding women of child bearing years). However, these studies have shown increasing fish consumption to reduce risk of coronary heart disease, can actually increase arrhythmia, and sudden death from cardiac causes.

ORD involvement:
Two pieces of research would directly benefit millions of people in R2 (as well as the other regions).

1) Examine levels of mercury exposure based on biomarkers of exposure (blood mercury or hair mercury) to see if there is an association with adult-onset neurological effects. There are limited data that show increases in certain neurological conditions (e.g., tremor, impairment of balance, sensory disturbances) among persons with moderately elevated methylmercury exposures. Such exposures are in a range currently considered without adverse effects. However, this may not be an accurate picture of the risks to adults.

2) Determine if there is an association between methylmercury exposure and coronary heart disease. Ordinarily this would require an additional cohort, but an opportunity exists to study an existing one. We can build upon the approximately six decades of research on cardiac conditions conducted as part of the Framingham Heart Study which began in 1948 under the direction of the National Heart Institute (now known as the National Heart, Lung, and Blood Institute of the National Institute of Health). The objective of the Framingham Heart Study was to identify the common factors or characteristics that contribute to cardiovascular disease by following its development over a long period of time in a large group of participants who had not yet developed overt symptoms of cardiovascular disease or suffered a heart attack or stroke.

Existing data for these cohorts (both the original cohort and the children of the original cohort) include detailed medical data on cardiac endpoints and other previously recognized risk factors. Stored samples of blood, hair, and nails are available which could be analyzed for methylmercury and total mercury. Expanding this data base to include mercury analyses and mining the existing medical data could provide additional clarity to a field in which there are two major cohort studies showing that methylmercury exposure is associated with increased risk of coronary heart disease and one study showing the opposite.



Cardiovascular Disease: New York's Leading Killer
(Source: NYS Department of Health)

REGION 3

Title: Developed and Developing Lands—Science to Support Local Decisions, Global Consequences: EPA's Role in Maintaining Landscape Integrity

Region 3 would like to work with ORD to enhance the scientific foundation necessary to understand the impacts of developed and developing lands on the integrity and function of our ecosystems and the services provided. This research/technical transfer would be utilized to support regional, state and local government policy/planning/strategy development, which relates to:

1) guiding and informing policy development, decision-making and strategic planning activities at all relevant scales

2) Land protection activities and mitigating impacts of urban sprawl, intensive, agriculture and mining activities in the mid-Atlantic

3) Protection and restoration of forests, wetlands and streams and other valued ecosystems

There have been many studies that suggest critical values for "stressors", such as impervious surface across a watershed, beyond which ecosystem integrity is impaired. However, each study has a different value, often depending on scale or ecosystem measures being considered. Therefore, some of the key research needs are:

1) What are the critical values for impervious surface and other critical ecosystem values beyond which ecosystems are impaired/imperiled?

2) What are the mitigating factors that lead to differences in studies and ultimately into field application of any values (e.g. landscape arrangement, scale, etc)? For example: How does the measure of imperviousness at different scales reflect a different approach to prescribing protection and restoration implementation strategies?

3) Alternatively, are their critical values for other landscape measures, such as extent of riparian forest, degree of forest fragmentation? Will these vary by scale as well? Is there a "hierarchy" of measures that would allow us to say that certain ones are more important for measuring overall ecological health?

4) How can EPA use such values to help states/local government manage ecosystem integrity, given its legislated role and authority?

5) Is there a real difference between assessing and managing for ecological integrity versus watershed integrity?

6) What are the economic and/or sociological benefits associated with incremental gains in forest cover or other landscape measures? Conversely, what are the "costs" to society in a broad sense - economically, public health, quality of life, long term sustainability - of not protecting and restoring ecological integrity? This would get us into the realm of what is compelling to those making local decisions that affect regional and ultimately global ecosystem function.

7) How can we consider climate change and attendant potential future changes like sea level rise, species migration (including humans), protection of "gray" infrastructure that would either depend on or impair GI/ecosystem function.

Development of a Green Infrastructure (GI) network would provide a coordinating mechanism to address the research needs and implement the results into practice. Research collaboration is needed on the following issues.

1) There are various methods used to identify and rank or value the components of a GI network (the "hubs" and "corridors/connectors"). What are the benefits or drawbacks of each approach? How can we best identify the critical linkages or essential areas of a GI network to maintain ecosystem integrity - or, how much is enough?

2) Are there ways to fairly quickly and simply identify and describe the ecosystem services provided by a GI network? Can we quantify them and develop tools to rank and prioritize the network for ecological, economic, and human health benefits?

3) What are the optimal scales at which GI should be assessed and managed for the various resources/services (i.e. is there an optimum scale for assessing ecosystem services that will vary by the particular service)?

4)What are the long term costs of not protecting high integrity components of the GI network from degradation, or restoring degraded areas within or adjacent to the network?

5) Can we develop tool to allow us to optimize a suite of best management practices (BMPs) depending on desired outcomes and relative to the condition of the landscape/watershed (i.e. degraded, pristine; or based on the mix of urban, rural - forested and agricultural, exurban, etc.). What are the efficiencies (related to ecosystem services

or desired outcomes) of LID and other BMPs, and can we generate some guidelines for management recommendations?
6) How do gray infrastructure improvements benefit the overall green infrastructure and how do we select and locate the grey infrastructure improvements which provide the most benefit?

Title: Mining—Impact Assessment, Compensatory Mitigation, and Conductivity

The EPA estimated that 724 miles (1,165 km) of Appalachian streams were buried by valley fills from 1985 to 2001 and that an additional 2,200 square miles (5,700 km²) of Appalachian forests will be mined using mountaintop removal by 2012. This is an area larger than the state of Delaware. The Clean Water Act mandates that states establish designated uses, and narrative and numeric water quality criteria to support those uses. All waters of the United States are designated for the propagation and protection of aquatic life. Numerous studies indicate that aquatic life can be adversely impacted downstream of mining operations in southern Appalachia. The mining increases pH, alkalinity, dissolved solids, and some metals. The mining effluent is not acidic, but alkaline.

Key areas for research collaboration include:

a) Impact Assessment – The focus of most regulatory and policy activities to mitigate the impact of mining is limited to direct impacts at the site. Although evidence suggests the environmental impacts extend far downstream from the sites, the notion is strongly resisted by the mining industry that claims the impacts of the active mining can not be distinguished from the numerous other stressors, especially legacy abandoned mining activities. Monitoring, modeling and risk assessment techniques are needed to address this issue.

b) Compensatory Mitigation – A great deal of ecological restoration is underway and planned to address the environmental damage from years of mining. The benefits of many of these restoration techniques are not clear nor based on sound science. Mitigation techniques to restore flow and function of streams are areas that warrant scientific inquiry. How many streams need to be restored, how do we measure function and how far downstream may impacts be occurring, are all pressing issues? This is especially true when dealing with headwater streams and isolated wetlands which are often obliterated without consideration of the vital function they play in ecosystem services.

c) Conductivity – Region 3's analyses of empirical datasets which include water quality, habitat and biological data, indicate that increased conductivity is most strongly correlated to impairment of the aquatic life. Appalachian streams are naturally very dilute. The strong correlation between conductivity and impairment of aquatic life could indicate that the increase in conductivity is having a direct toxic effect, or it could indicate that conductivity is simply a surrogate indicator for mining intensity, and for other parameters related to mining such as exposure to dietary metals. It could be that metal uptake is actually causing the impairment. Mayflies seem particularly sensitive to the water quality changes and are often severely reduced or completely absent from streams downstream of these mines. We still don't know what specific parameters are causing the impairment, or what the mechanism of impairment is. It would be extremely

helpful to identify the actual stressor causing the impairment. This could lead to changes in water quality standards, permits, and other water quality controls. These changes could help to protect thousands of miles of streams that have not been mined, and could perhaps help to restore thousands more miles of streams that have already been degraded. Research questions include:

1) Does elevated conductivity have an acute or chronic toxic effect on the resident aquatic life? What is the mechanism? Does the elevated conductivity interfere with osmo-regulation in aquatic insects or is there some other physiological endpoint?

2 Are the aquatic life bio-accumulating metals via the water column or their diet? Metal toxicity occurs when metal influx exceeds an animal's ability to eliminate or detoxify metal. Do physiological differences between organisms explain why certain orders are more sensitive than others to the water quality changes?

3) This type of large scale surface mining impairs aquatic life in streams, but also affects other functions of streams. Certain sections of the Clean Water Act (e.g. 404) focus on protecting the function of streams, as well as structure. Therefore, we are also interested in continuing to support research that explores the impact of large scale surface mining on sediment and nutrient retention and transport, organic matter processing, primary production, secondary production, etc.

REGION 4 (not ranked)

Title: Influence of Diet and Soil Mineralogy on Arsenic Bioavailability

Arsenic in soil continues to be an important contaminant of concern at sites throughout Region 4 and elsewhere. There is considerable evidence in the published literature that arsenic in a soil matrix is not well absorbed, and consequently an adjustment in risk-based cleanup goals to account for diminished bioavailability could be justified at many sites, resulting in potential savings in cleanup costs. The issue is determining how much of an adjustment to make. Arsenic bioavailability from soil varies from site to site, likely due to differing chemical species of arsenic, and consequently must be measured on a site-specific basis. Arsenic bioavailability from soil can be measured using animal models (currently, non-human primates and swine are the primary models) or estimated by *in vitro* extraction tests. Currently, the predictive capabilities of arsenic *in vitro* extraction tests are not considered sufficiently reliable for regulatory decision-making, and recently an issue has been raised whether the standard method of measuring bioavailability *in vivo* using fasted animals is health protective. The proposed research will address the latter issue directly, and will advance the development of reliable *in vitro* methods that offer the potential for rapid, less expensive bioavailability assessment at arsenic contaminated sites.

The standard protocol for measuring arsenic bioavailability *in vivo* uses fasted animals. It has been commonly assumed that the fasting state enhances arsenic absorption, and that bioavailability measurements under these conditions represent a conservative estimate of arsenic absorption in humans. Recently, *in vitro* evidence suggests that extraction of arsenic from soil may be enhanced by the presence of food, indicating that measurement in fasted animals may actually underestimate absorption. To

address this question, the effect of food and food composition on arsenic absorption from soil will be evaluated in non-human primates. By expanding the standard arsenic bioavailability protocol to include both fed and fasted conditions, the information from this project will complement a Region 4 study in progress designed to measure arsenic bioavailability from orchard soils at a North Carolina Superfund site. Products that would result from the research include a peer-reviewed scientific paper on the effect of fasting status on arsenic bioavailability measurement and a recommendation as to whether the standard measurement protocol should be modified to include fed animals. This research would have direct impact on current arsenic bioavailability measurement approaches in all Regions. Because this research builds upon an already-funded site bioavailability assessment, it leverages ORD support to accomplish research objectives at a much lower cost than would otherwise be possible.

A second aspect of the proposed research will be to examine relationships between soil mineralogy and arsenic bioavailability. This is a critical step in developing an *in vitro* method for rapid, reliable estimates of site-specific arsenic bioavailability. Detailed soil mineralogy will be determined for the North Carolina site soils, as well as 14 other soil samples with arsenic bioavailability previously measured in non-human primates. The product of this research will be a model that relates soil arsenic mineralogy to bioavailability in non-human primates. If the model is sufficiently predictive so as to be suitable for regulatory purposes, this could dramatically reduce the cost and time required to make bioavailability adjustments for arsenic site cleanups. Consistent with the first aspect of this proposal, it leverages ORD support with other studies (in this case, non-human primate studies measuring arsenic bioavailability in 14 soils) to achieve results at relatively low cost.

EPA ORD Collaborators:
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Title: Watershed and Airshed Factors Affecting Mercury Methylation

Problem Statement: Spatial depiction of mercury risk is overly generalized.

Data on atmospheric mercury inputs must be extrapolated over wide areas. Information on human health risk via game fish tissue monitoring, as well as on ecological risk to top predators inferred from forage fish surveys, is either specific to particular sampling stations or to entire statistical sampling frames. In all cases there is no watershed-scale treatment of the issue that is widely applicable.

Background: Much data is available, but has not been synthesized.

Empirical data on mercury deposition is becoming more available, as is data on its accumulation in aquatic receptors at large spatial scales. Process-level measurement and modeling of methylation has also been accomplished in many aquatic ecosystems around

the country. Inductive synthesis of this available information in a watershed context would have widespread benefits.

What Is Needed: A model that predicts where methylation is most likely.

Explicit linkages between atmospheric, terrestrial, and aquatic processes are envisioned. Extensive use of digital data layers, both from meteorological networks and watershed-scale terrestrial sources, may be combined in a GIS environment with mass-balance models based on coefficients derived from mercury speciation, transport, and methylation process studies.

Implications of No Action: Inefficient management of Hg stressors.

Mercury contamination is a problem that is as ubiquitous as it is unique. As an atmospherically derived water pollutant, it requires novel approaches for targeting efforts at risk assessment and reduction, developing TMDLs that are meaningful and effective, and obtaining pollution prevention results that are measurable at the community level. With limited options and resources available to respond to increasing global emissions, improved comprehension of geographic disparities in mercury exposure would enable prudent use of appropriate mitigation strategies.

EPA Contacts: Peter Kalla and John Ackerman

Title: Life Cycle Construction Initiative

Problem Statement: Typically, today's construction industry does not take into consideration the lifecycle impact of buildings and the practices associated with construction and demolition.

Background:
As a result of our exploding growth in the Southeast, EPA Region 4 and the States are faced with the increasing challenges of environmental issues surrounding construction projects. At the end of their useful life, buildings and structures are usually demolished. Typically, new construction does not consider that internal walls may be removed or added, that built-in cabinetry may be ripped out to make way for new cabinets, and that the demolition debris may have useful components. Millions of tons of construction and demolition debris are land-filled annually. Construction site managers are generally focused on the task at hand and typically do not consider the water, air and waste impacts of their projects when they are being regulated.

What Is Needed: Professionals in the design, construction, demolition, and remodeling business need an increased understanding of the environmental effects of the entire lifecycle of their projects. Region 4 is inviting these professionals to take a holistic approach to the construction and demolition process by bringing other stakeholders to the table. A dialogue between the construction industry, federal and state regulators, and local government officials is needed to introduce this holistic approach, which considers design for disassembly; construction and demolition debris recycling; building material reuse; diesel emission at construction sites; hazardous waste, such as asbestos and lead;

storm water and sediment loading; and revitalization/Smart Growth. The meeting will include presentations on the latest technology and designs available with a series of case studies that will demonstrate the feasibility of this holistic approach.

A one-day meeting will bring together the construction managers, architects/design professionals, primary contractors, federal, state and local government regulators and owners of businesses within the field of lifecycle construction. The meeting would include an educational component but one-half of the agenda would be facilitated discussion to develop a series of collaborative approaches to lifecycle construction. The hope is that the discussion will continue through a series of meetings and initiatives consisting of business leaders and regulators setting out to explore this new concept and implement change regarding Lifecycle Construction. Currently, contractor support has been secured from an expiring contract; however, an additional $20,000 is needed to make this meeting a reality. The meeting is slated for mid-March 2008.

Implications of No Action: This initiative has the potential to literally change the way the construction industry and the public view construction sites. This initiative is not only beneficial for the Southeast, but has national implications for construction sites everywhere. No action will result in the continued practices of no coordination regarding the air, water and waste impacts of the construction industry, and result in another missed opportunity to collaborate on a multitude of environmental issues with widespread implications.

EPA Contacts: Pam Swingle 404-562-8482 Latoya Miller 404-562-9885

Title: Closed-Loop Manure Treatment/Energy Production Systems for Small- to Medium-Sized Animal Operations

Problem Statement: An alternative to traditional lagoon and spray field systems for swine and dairy operations should be implemented to reduce water, waste and air quality problems.

Background**:** Agriculture is a vital part of the economy, culture and history of the Southeast. Farmers and ranchers provide food, feed, fiber and some fuel using plants, animals and their by-products. Region 4 is home to more than 4.8 billion broilers and turkeys, 11.5 million hogs and pigs, 5.6 million beef cows and heifers, and 519, 000 dairy cows. Manure from the traditional “wet” treatment systems (swine and dairy operations) can present significant environmental problems. Typically the manure is flushed from the barns, treated in the lagoon to reduce its pollution potential and then land applied to cropland or hay fields. Problems occur when manure runs off fields, effluent leaks from the bottom and sides of the structure or flows through a dam breach to contaminate surface or ground water. Additionally, odors and particulate from the lagoon and land application sites can be a problem for the local community.

Revision of the CAFO rule may also lead to negative, unintended environmental consequences. Initial feedback from the Region 4 states indicates that a majority of

current CAFOs will not request a permit and will certify that they are "no discharge" systems, thus not subject to the Clean Water Act. Additionally, AFOs (smaller operations) will continue to be exempt from the new regulations. For most Region 4 states this means that an emphasis will not be placed on inspecting these operations, since they have no permit. Opportunities to catch problems early and advise producers on proper management will be lost.

A final factor in this equation is the increased cost of production because of the growing biofuels industry. Corn for ethanol production has pushed the price for corn-based feed to increasingly high levels, cutting into the profits for small- and medium- sized animal operations. This factor may contribute to less money being available for upgrades or maintenance of existing animal facilities.

What is Needed**:** Scientists at North Carolina A&T University have proposed a research project to develop a closed-loop manure treatment/energy production system for small- to medium-sized swine or dairy operations. This system will separate the solid and the liquid waste. The solids will be mixed with hay or cotton gin waste and processed using gasification to produce energy for use on-farm. The liquid portion of the waste stream will pass through calcium oxide and geolite towers to absorb the phosphorus and ammonium. The resulting liquid has a reduced odor and nutrient content. At this point the liquids can be land applied as a soil amendment or diverted through a constructed wetland for final polishing. The liquids leaving the wetland will be re-circulated back through the barns as flush water, resulting in a closed-loop system.

Implications of No Action**:** Farmers in the Southeast will continue to use their lagoon and spray field systems as a means of waste treatment and disposal. Many will have an increased potential to pollute the environment since they will operate unpermitted facilities that may not be inspected.

EPA Contact**:** Denise Tennessee, Agriculture Program Coordinator, Office of the Regional Administrator

REGION 5

> **Title:** Development of Health Based Standard for Asbestos Concentrations in Air and Assistance to Region for Proposed Use of Taconite Tailings as Road Aggregate

Problem Statement:
1. Develop and promulgate an emission standard applicable to taconite processing facilities that would cover both asbestos and asbestos-like fibers.
2. Provide technical assistance to Region 5 regarding the use of taconite tailings as road aggregate.

Background:

This operating taconite mine, formerly the Reserve Mine, remains legally subject to an enforceable court-imposed standard that limits its fiber emissions to a level below background levels measurable in downtown St. Paul, Minnesota (the so-called "control-city" standard set by the U.S. District Court in United States et. al., versus Reserve Mining Co.). The current owner contends this standard was long-ago complied with and has filed a motion with the court to reopen the case in an effort to relieve itself of this on-going monitoring responsibility. If the court hears this appeal, the original plaintiffs, which include U.S. EPA, the States of MN, WI and MI, and several cities, may need to coordinate a response in defense of this current standard.

The tailings from several operating taconite mines are currently being evaluated for widespread commercial use as a road aggregate. Already, some 100 miles of public roadways in Minnesota have been constructed of this material on an experimental basis. Some taconite tailings from the eastern end of the Iron Range, specifically those from the Northshore Mine, are known to contain cummingtonite-grunerite and ferro-actinolite asbestiform fibers, along with a variety of other "asbestos-like" mineral particles of undetermined toxicity. Under existing procurement specifications, these tailings are currently restricted from use on roadways by the MN Dept. of Transportation. The tailings from taconite mines at the western end of the Iron Range, however, which are now being used for road aggregate, have been studied to some extent, and reportedly do not contain "regulated asbestos fibers." Because communities throughout the entire Iron Range are now experiencing unusually high rates of mesothelioma disease, state health authorities have raised questions about whether these diseases might somehow be connected to or possibly caused by exposures to taconite dust. Although no causal relationship has been established, the State Health Department and the University of Minnesota, at the direction of the Governor, are presently collaborating in an effort to design and conduct epidemiological research that will be aimed at testing this hypothesis.

Science Needs: Development of a health based standard for asbestos concentrations in air to include all fibers present in taconite ore of Minnesota and Michigan.

Assist Region 5 in testing protocols to determine the health consequences of using taconite tailings as road aggregate.

Title: Nutrient Control with Better Understanding of Winter Runoff of Surface Applied Animal Manure

Problem Statement:
Produce scientific information to guide Regions and States in developing manure spreading rules to prevent nutrient run off to waters.

Background:
The project involves the following science topics: precipitation runoff hydrology, water analysis, gravity settling of discrete particles, microbial oxidation of carbon and nitrogen, and agronomy. The project addresses the following surface water quality issues: hypoxia as a cause of mortality to fish and other aquatic life, ammonia toxicity to fish and

other aquatic life, nutrient-induced eutrophication, sedimentation, pathogenic organisms as a cause of infections in humans, and wet-weather sources of water pollution. Land application of animal manure and process wastewater is among the documented reasons why these issues arise in Region 5, sometimes with serious consequences. For example, in a recent 12-month period, Wisconsin documented 39 runoff or discharge incidents from land application of manure. One winter event wiped out ten years and $0.9 million of restoration work in one watershed. In other major winter events in Wisconsin, improper land application caused gastroenteritis in humans and killed the fish population of a lake. Based in part on these incidents, the strategic plan for the Water Division recognizes that we are collaborating with the Office of Research and Development, Office of Water, and the United States Department of Agriculture (USDA), Agricultural Research Service, to improve the scientific foundation for EPA's national guidance for land application of manure in the winter (Managing Manure Nutrients at Concentrated Animal Feeding Operations (CAFOs), Appendix L).

Goals:
Promote progress toward the Water Division goals that all waters in Region 5 will support healthy aquatic biological communities and that designated swimming waters will be safe for swimming.

Science Needs:
Develop correlations of manure nutrient concentration and land application rate with nutrient run off based upon climate and soil condition.

REGION 6

Title: Development of an Alternative Asbestos Control Method (AACM)

Problem Statement
In response to Section 112 of the Clean Air Act, which requires EPA to develop emission standards for hazardous air pollutants, EPA promulgated the National Emission Standards for Hazardous Air Pollutants (NESHAP). Specifically, 40 CFR Part 61 Subpart M addresses asbestos, including demolition activities, and is commonly known as the "Asbestos NESHAP." The Asbestos NESHAP requires an extensive procedure for removing asbestos when buildings are demolished. Because the procedure is so costly, many communities are forced to leave derelict buildings standing for lack of funding to demolish them. A new, less costly but still environmentally protective method is needed for demolition.

Background
Briefly described, the Alternative Asbestos Control Method (AACM) removes the most friable asbestos-containing materials before demolition, but leaves some asbestos containing materials (primarily wall systems) in place. The most friable asbestos - containing materials are removed under the requirements of the Asbestos NESHAP and are disposed of properly as asbestos-containing wastes.

Once the most friable asbestos-containing materials are safely removed, the demolition proceeds using amended water suppression before, during, and after demolition, in order to trap asbestos fibers and minimize their potential release to the air. Wastewater generated during the demolition is collected, and all contaminated materials are properly disposed as asbestos-containing waste. A two-inch layer of soil is removed to ensure that no residual soil contamination remains at the site.

NRMRL engineers in Roger Wilmoth's group worked with Region 6 engineers on demonstrating the new method. The method was tested (Demolition #1) at Ft. Chaffee, AR in April, 2006, by demolishing two virtually identical side-by-side buildings, one using the common NESHAP method and the other using the AACM. The AACM performed well, being as environmentally protective, but being faster and cheaper. A second demolition at Ft. Chaffee, using a two-story structure (Demolition #2), was completed in July, 2007.

What Is Needed:
The results of the first two demolitions were very promising, but further research is needed to prove the applicability of the AACM under a variety of conditions. The ultimate result could be millions of dollars of savings for cities and much faster action in removing old buildings so that other uses can be made of the land.

Continued ORD support is needed highlighting the science and data associated with all demolition projects completed and scheduled. Demolitions #1 and #2 have been completed, with Demolition #3 being scheduled at a different site in Region 6. If funds permit, a fourth demolition would increase the types of asbestos listed in the amendment contemplated for NESHAP, allowing the AACM as a demolition procedure.

Implications of No Action:
The ultimate result of no action could be millions of dollars wasted for cities and a long delay in demolishing old buildings, preventing the re-use or renewal of the land..

EPA Contacts:
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REGION 8

Title: Permitting for Clean Energy in Region 8

Background:
The Energy Policy Act of 2005 strongly encourages increased development of domestic energy resources to enhance our nation's economic and physical security by reducing dependence on foreign fuel sources. The National Energy Policy calls upon the nation to "accelerate the protection and improvement of our environment" in relation to energy activities which has resulted in an increased number of energy-associated applications, permits and environmental assessments. As the nation focuses on our energy

independence, EPA is faced with the challenge of addressing significantly greater workloads to ensure environmental protection during all phases of energy development and production, and more efficiently and quickly fulfilling our legal responsibilities related to those energy activities. EPA is experiencing a marked increase in energy-related direct implementation permitting and NEPA document reviews. Energy related NPDES permitting work is expected to increase and Region 8 is preparing for the first time workload of approximately new 200 New Source Review (NSR) minor source permits to be issued. Region 8 has been involved with 19 NEPA documents which propose 58,509 additional well installations on over 10.8 million acres of federal mineral estate and 7.23 million acres of public land ownership within the Region. New rule development and national permit work related to carbon sequestration is expected to add to this existing workload.

What is Needed:
Environmental issues are a significant part of every energy industry endeavor whether exploiting new natural gas resources or coal bed methane in the western US or extending field development in coastal areas of the US. New, innovative technologies are needed to exploit natural resources with a reduced environmental footprint.

There may be as many as 20,000 coal bed methane (CBM) wells in the Western US. In the Montana/Wyoming Powder River Basin alone, there are over 10,000 CBM wells and up to 10 new wells are drilled each day. Each well must de-water the aquifer to allow the methane to be captured. The average formation water from each well is about one million gallons per week and this water is discharged to streams or ponds with little captured for any beneficial use. Aquifer drawdown impacts large areas, groundwater and surface water is contaminated, streams and local environments are altered. New cost effective technologies are needed to capture, conserve, reuse and otherwise not waste the formation water from these wells. Additionally, environmentally friendly drilling methods that reduce the overall impacts from drilling new CBM wells and minimize the volume of formation water are needed and better, less expensive treatment methods that reuse, re-inject or return the clean formation water back into drinking water aquifers are needed.

Produced water is the number one waste management issue related to drilling and production operations. New, innovative technologies are needed to generate useful products from produced water associated with oil and gas production.

In addition to the innovative technologies mentioned above, there are a number of other science needs related to increased energy development in Region 8, such as:

How to address the potential and cumulative impacts on air and water quality as a result of the current and future projects occurring across the Rocky Mountain Region.
How can we quickly locate leaks or venting from the oil and gas wellsites, quantify fugitive gas discharges and emissions and evaluate the health impacts?
What are the best available technologies for oil and gas activities and how can we stay current with advances in these technologies?
What are the lessons learned from the most current practices?
Which air models should be used by the NEPA program to determine thresholds for amounts of land to be leased for various oil and gas activities?
How can specific Region 8 geographic locations be included as pilot studies for innovative oil and gas technologies?

Title: Assessment of Mercury in the Great Salt Lake Ecosystem

Background:
Recent studies by the U.S. Geological Survey and others have revealed high mercury concentrations in the Great Salt Lake (GSL). These mercury values are the highest reported for any open water in the United States. The Great Salt Lake and its associated wetlands are one of the most important ecosystems for migratory waterfowl in the western United States. The GSL is a major stop over for waterfowl along the Pacific Flyway. Tissue analysis from three species of migratory waterfowl in the GSL resulted in the nation's first ever mercury advisory. (Utah Division of Wildlife Resources Sept. 29, 2005 and Sept. 21, 2006 advisories)

Water column analysis by the U.S. Geological Survey (USGS) and Kennecott Copper has yielded mercury values that far exceed values in natural waters found elsewhere in the United States. Methyl mercury values observed by USGS were as high as 26 ng/L (Naftz, 2005) and 80 ng/L in studies sponsored by Kennecott Copper (Adams 2005).

The GSL has local point sources for atmospheric and effluent Hg-loading. Utah's industrial and mining operations are potential sources of mercury in the GSL watershed. Gold mines in northeastern Nevada, upwind of Salt Lake City, have reported releasing large amounts of mercury into the atmosphere. Other sources include coal-fired power plants and the Kennecott and US Magnesium smelters. There are many industrial sources that also discharge directly into the GSL.

There is currently no air deposition monitoring at or near GSL. A variety of studies are proposed to evaluate both the extent of contamination and the impacts of mercury on wildlife in the area. A source assessment will be needed to determine significant sources (both air deposition and effluent) and to quantify their mercury loads to GSL.

What is Needed:
The GSL ecosystem is large with extensive wetlands and waterfowl areas that serve as a major migratory flyway. The interaction between waterfowl, their food chain and lake sediments, surface waters and air have not been extensively studied. The mechanisms that result in mercury moving into and up the food chain are generally known from other studies. The specifics of the GSL ecosystem, however, have unique characteristics that require additional study to quantify the temporal and spatial distribution of mercury in the GSL ecosystem including air, water column, sediments, waterfowl and waterfowl food chain biota to identify sources of mercury;

REGION 9

One common theme among several of these priorities is the need for ORD to ensure that the unique characteristics and environments of the arid western portions of the country are incorporated into research goals, pilot projects, and outreach.

Title: Respond to Harmful Algal Blooms (top short-term priority)

Problem: Harmful algal blooms (HABs) have been increasingly observed in fresh and marine waters in EPA Region 9. Adverse human health and ecological effects occur via direct intake of aqueous toxins and ingestion of contaminated food resulting in liver or nerve damage, or via dermal contact producing skin rashes.

Need: We have an immediate need for improved monitoring methods, including development of standards for QA/QC and rapid field detection techniques, to support improved prediction and modeling of bloom occurrence and toxicity. We also need improved prevention and control techniques and better risk assessment methods.

Title: Advanced Clean Air Technologies for Mobile Sources (top technology priority)

Problem: California has the highest concentrations of ozone and fine particulate matter (PM2.5) in the country. We will need to achieve a drastic amount of emission reductions to meet the NAAQS for both 8-hour ozone and PM2.5.

Need: Initially, Region 9 is seeking to partner with ORD and OAR to host a workshop with state, local and industry partners to identify promising technology advances and further research needs.

Title: Formation of PM2.5 (top long term research priority)

Problem: The San Joaquin Valley and the South Coast air basin have the highest levels of 24 hour PM2.5 in the country. We lack adequate understanding of the important contribution of high levels of ammonium nitrate and secondary organic aerosols (SOA) to total PM2.5 levels. A better understanding of this problem is needed for air quality planning.

Need: Long term research is needed to improve understanding of the chemistry of secondary organic aerosol (SOA) and ammonium nitrate formation mechanisms under ambient conditions using chamber or other experiments, and field study measurements.

Title: Advanced Technical Tools for Determining CWA Jurisdiction (top priority for science tool development)

Problem: The recent Supreme Court decisions on the definition of “waters of the U.S.” may significantly impact intermittent or ephemeral streams, which are over 80% of total stream length in the southwestern United States. Maintaining vital regulatory protections for these waters is likely to depend upon the government’s ability to demonstrate a significant physical, chemical and/or biological “nexus” between these tributaries and downstream navigable waters.

Need: Establish a scientifically rigorous toolkit and associated methodology to establish a scientifically defensible basis for CWA jurisdiction in arid environments.

Title: Pyrethroids in Water and Sediment: Improving Assessment and Management Tools (build on existing efforts)

The substantial increase in the use of pyrethroids is a growing concern in Region 9, which has the largest agriculture region in the country. Increasingly, water impairment in Region 9 is being related to pyrethroids. Better methods are needed to monitor, evaluate and control pyrethroids in our waters and sediments. We are looking for ways to build on existing research efforts in ORD to address pyrethroids.

Title: Contaminated Vapor Intrusion into Buildings: Improving Methods for Site Investigation (build on existing efforts)

Better understanding of this important pathway at hazardous waste sites is critical. Improvements to existing modeling approaches are needed. We are seeking continued ORD support for current efforts to evaluate model uncertainty and sensitivity with increased regional involvement.

Title: Biodiesel Life-Cycle Analysis (build on existing efforts)

Efforts to develop national criteria for sustainable biodiesel are underway and, to our knowledge, ORD is involved in this effort. We are seeking to develop a life-cycle analysis of biodiesel to better quantify the environmental benefits and/or tradeoffs and to help evaluate the sustainability of this alternative fuel.

REGION 10

Title: Children's Health in Alaska

Problem Statement:
Alaskan children face disproportionate and unique environmental exposures. The north is a hemispheric sink for persistent organic pollutants, such as PCBs, pesticides, and dioxins that threaten ecosystems and human health. These toxins can cause cancers, neurological and learning disabilities, hormonal disruption, and changes to reproductive and immune systems. The cold environment and subsistence diet favors the retention and accumulation of these toxins. Within Alaska, the environmental fate and transport of contaminants in outdoor air, indoor air, water and soil uniquely differs from processes in the contiguous 48 states. Hence, the nature of Alaskan children's exposures differs, as well. Research on the impacts of environmental toxins to children in Alaska is limited. Region 10 is unable to identify any ORD intramural or extramural research activities involving children's health in Alaska. Additionally, the proposed National Children's Study, which is intended to address many questions on children's environmental health, includes no studies sites in Alaska. These gaps in the current and proposed research must be addressed in order to fully understand and prevent negative health outcomes in Alaskan children.

Background:
Children are especially vulnerable to environmental toxic exposures. Unlike adults, their bodies are still growing and developing; they also have unique exposure pathways during their early years of rapid growth and development. These factors put them at an increased risk from pollution, toxins and other environmental threats. Alaska is home to nearly two hundred thousand children and has the Nation's highest percentage of Native peoples, roughly 16% of its population.

Native Alaskan children, who live in remote villages, have additional risk factors that must be studied and addressed. For example, studies have demonstrated a correlation between living close to a rural Alaska dump and adverse birth outcomes, including low or very low birth weight, preterm birth, and intrauterine growth retardation. This study by Gilbreath and Kass is the first on this issue and the findings illustrate the need for additional research.

Climate change impacts in Alaska are supported by ample empirical evidence of a warming arctic. Increased wildfires impact air quality. Thawing tundra and loss of shore fast ice result in inundation of waste storage facilities, and damage to drinking water and sewage infrastructure systems. The advanced seasonal progression of the Spring thaw has resulted in the northward movement of subsistence resources such as berries, wildlife and fish, as well as the appearance of species never before seen. The stress of these and other climate change impacts adds to the existing environmental burden which impacts the health of children in Alaska.

What is Needed:
In order to meet its tribal trust responsibilities and address these research gaps in ORD's intramural (preferred) and extramural research activities, as well as in the National Children' Study, ORD should include research activities primarily focused on children's health in Alaska. In developing and implementing this work, ORD scientists and grant recipients should work in a collaborative or consultative fashion with Region 10. ORD should always let Region 10 know, in advance, when Alaska studies will be conducted and when ORD scientists will be traveling to Alaska. ORD and Region 10 should jointly develop research communications and outreach, as well as activities which convey the results of the research to Alaskan users of the information. The joint activities described will assure that research is focused on Region 10 relevant environmental problems, and that the research results reach appropriate audiences.

Implications of No Action:
If this research is not conducted, neither EPA nor users of the results from the National Children's Study will be enabled to effectively respond to important issues regarding adverse health outcomes for children in Alaska. Without ORD intramural (preferred) or extramural research on specific environmental issues impacting the health of children in Alaska, EPA will not be enabled to develop air quality standards, air permits, waste management practices, siting or relocation of waste facilities (later necessitated by inundation or breaching of existing facilities due to impacts of climate change) and administer general assistance grants to Tribes in a manner that improves the health of

Alaskan children. We will likely see a continuation of negative health outcomes in Alaskan children, especially in the Native Alaskan population.

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